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Applicant: Yan Zhou and Seng-Tiong Ho
Title: INTEGRATED PLANAR COMPOSITE COUPLING STRUCTURES
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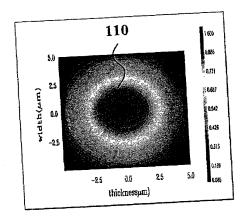


FIG 1 (a)

FIG 1 (b)

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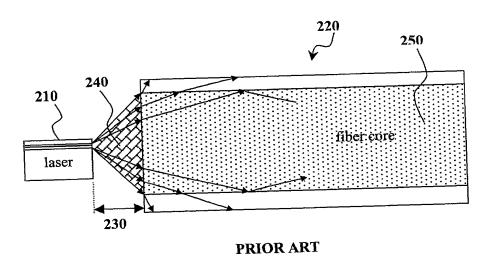
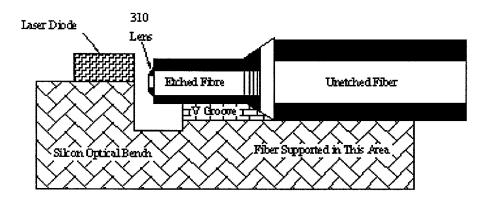


FIG 2

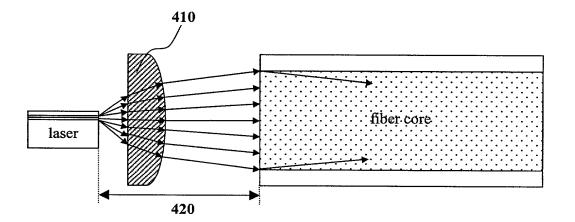
Atty. Docket No.: 021040-000300
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**PRIOR ART** 

FIG. 3

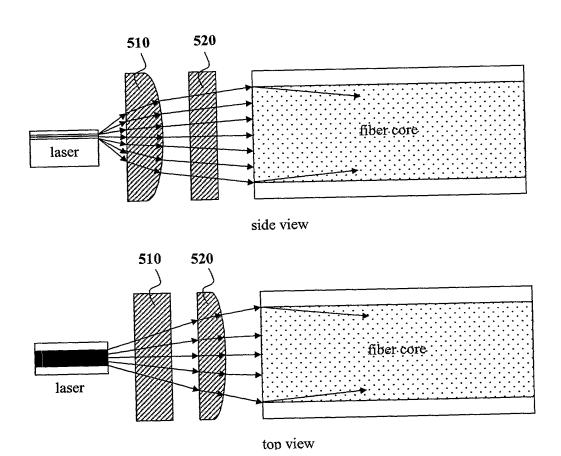
## Atty. Docket No.: 021040-000300 Applicant: Yan Zhou and Seng-Tiong Ho Title: INTEGRATED PLANAR COMPOSITE COUPLING STRUCTURES FOR BI-DIRECTIONAL LIGHT BEAM TRANSFORMATION... Sheet 4 of 59



#### **PRIOR ART**

FIG. 4

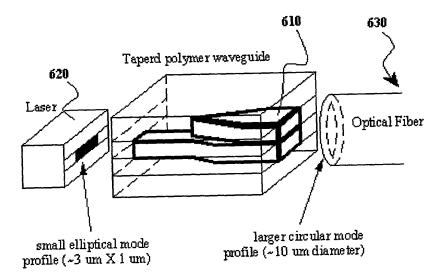
### Atty. Docket No.: 021040-000300 Applicant: Yan Zhou and Seng-Tiong Ho Title: INTEGRATED PLANAR COMPOSITE COUPLING STRUCTURES FOR BI-DIRECTIONAL LIGHT BEAM TRANSFORMATION... Sheet 5 of 59



#### PRIOR ART

**FIG. 5** 

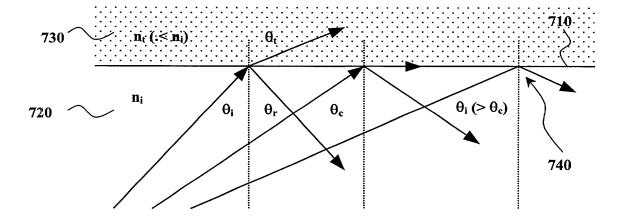
Atty. Docket No.: 021040-000300
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#### **PRIOR ART**

FIG. 6

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**FIG 7** 

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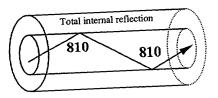


FIG 8

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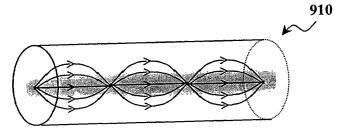


FIG 9

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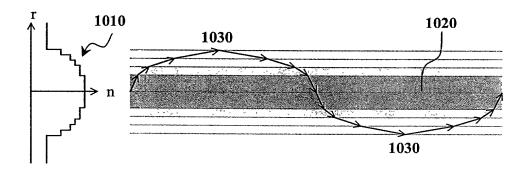


FIG 10

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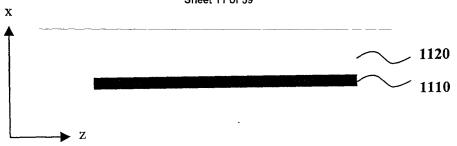


Fig 11A

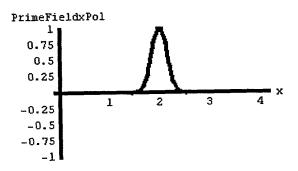


Fig 11B

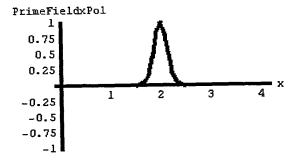


Fig 11C

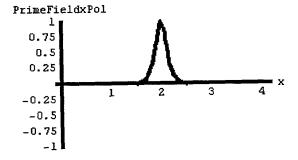


Fig 11D

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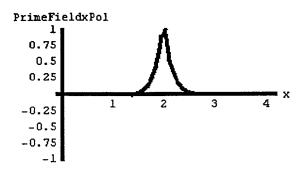


Fig 11E

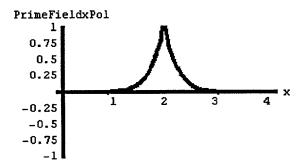
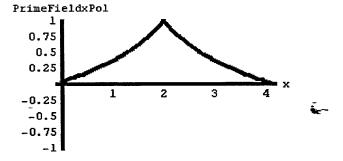


Fig 11F



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Fig 11G

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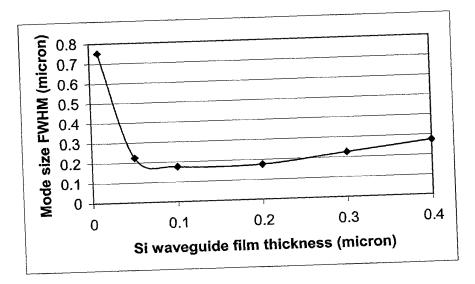
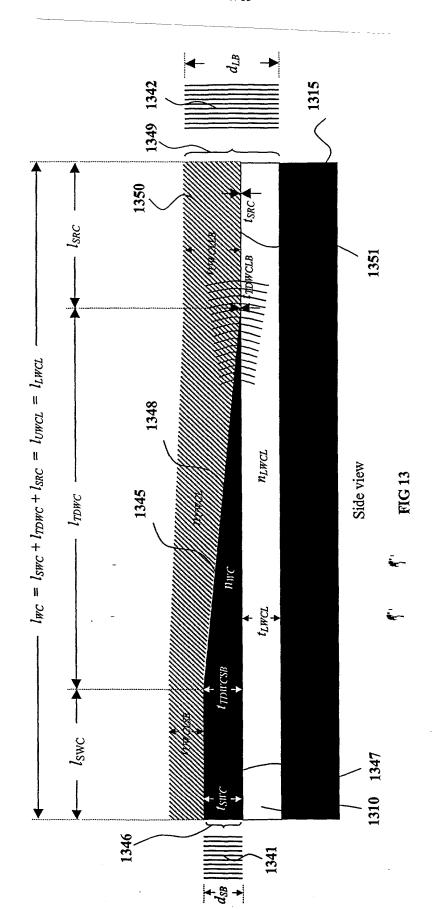


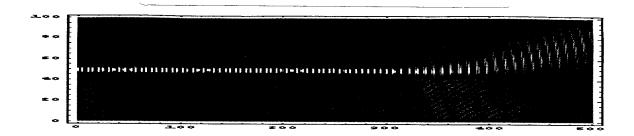
FIG. 12

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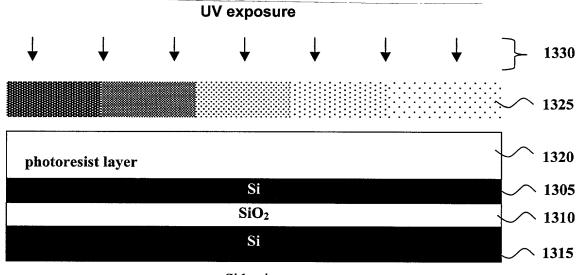
Atty. Docket No.: 021040-000300
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**FIG 14** 

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Side view

Fig 15A

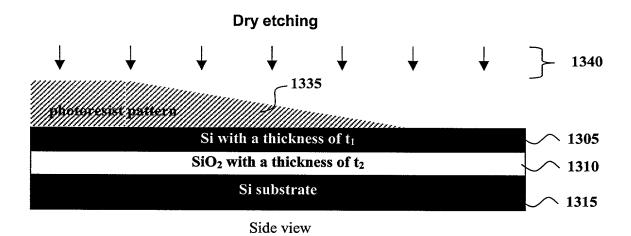


Fig 15B

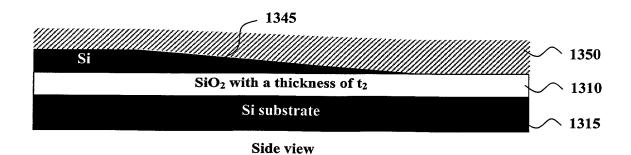
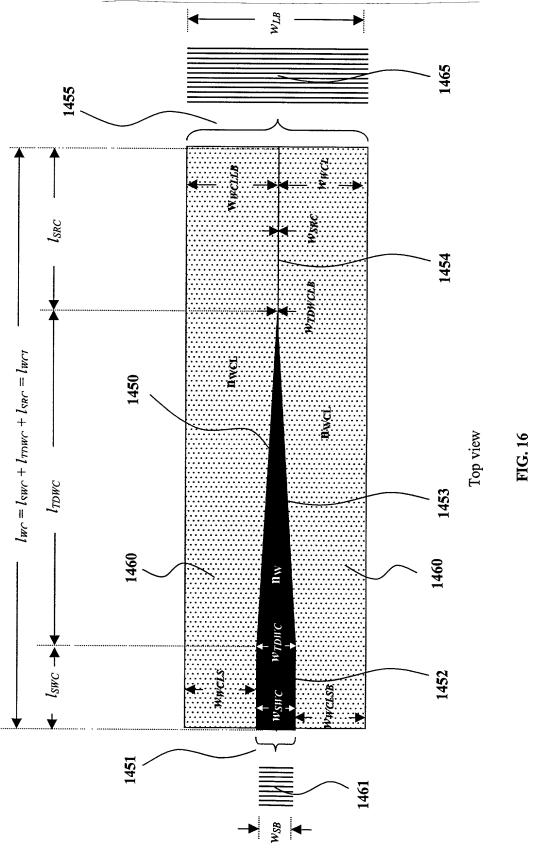
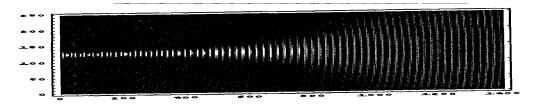


Fig 15C

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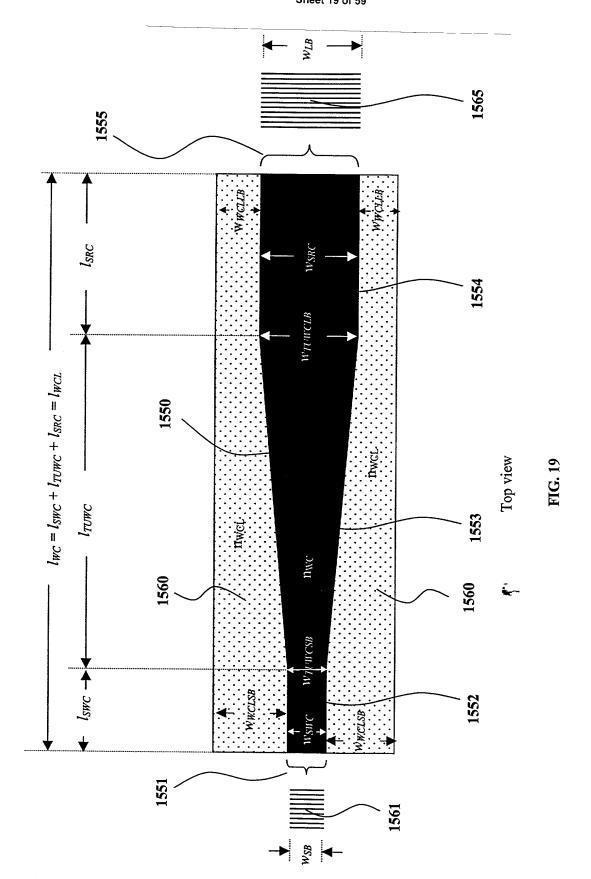
## Atty. Docket No.: 021040-000300 Applicant: Yan Zhou and Seng-Tiong Ho Title: INTEGRATED PLANAR COMPOSITE COUPLING STRUCTURES FOR BI-DIRECTIONAL LIGHT BEAM TRANSFORMATION... Sheet 18 of 59



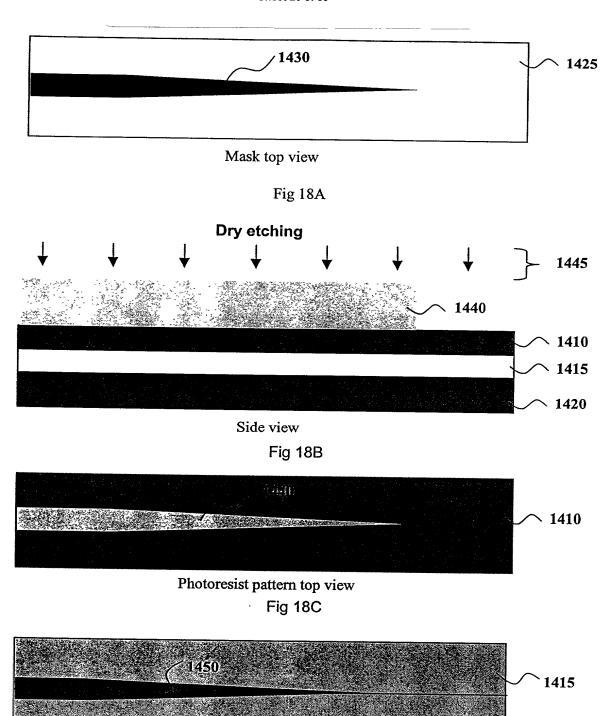
**FIG 17** 

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Si tapered down/narrow section top view

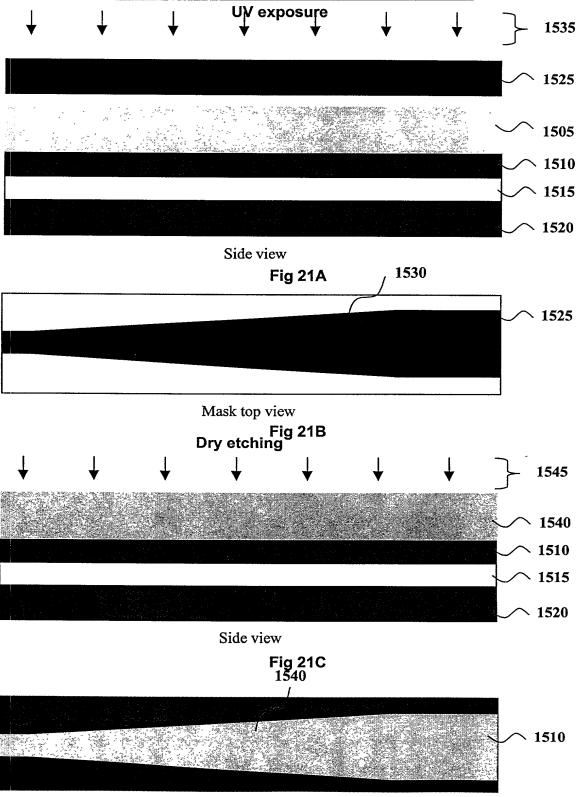
Fig 18D

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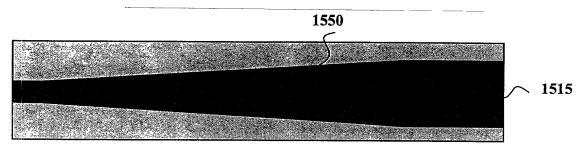
Fig. 20

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Photoresist pattern top view Fig 21D

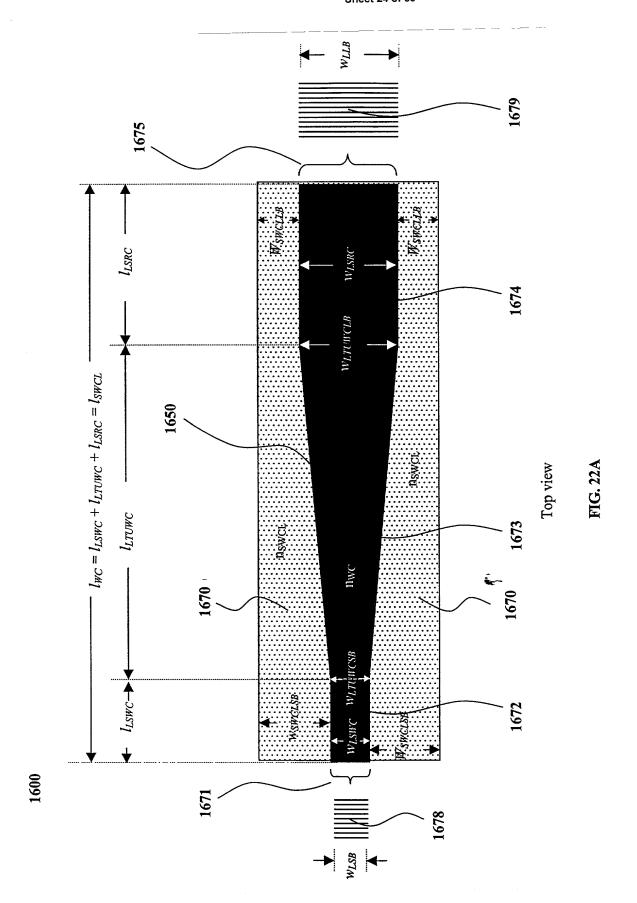
## Atty. Docket No.: 021040-000300 Applicant: Yan Zhou and Seng-Tiong Ho Title: INTEGRATED PLANAR COMPOSITE COUPLING STRUCTURES FOR BI-DIRECTIONAL LIGHT BEAM TRANSFORMATION.. Sheet 23 of 59



Si tapered up/wide section top view

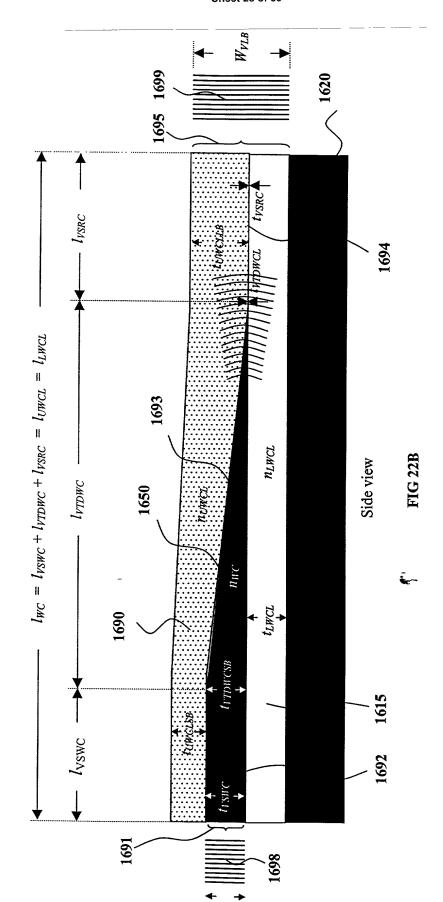
FIG. 21E

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Theorem an

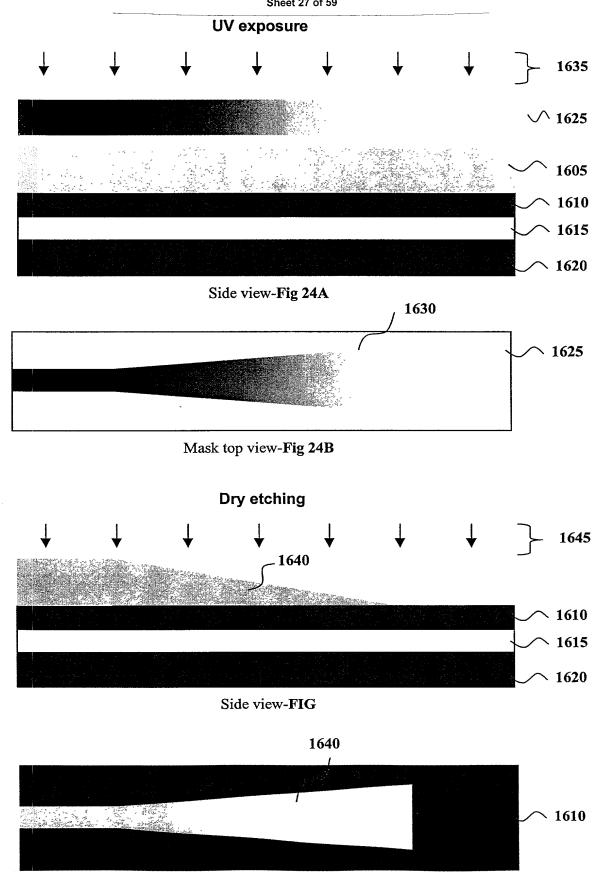
## Atty. Docket No.: 021040-000300 Applicant: Yan Zhou and Seng-Tiong Ho Title: INTEGRATED PLANAR COMPOSITE COUPLING STRUCTURES FOR BI-DIRECTIONAL LIGHT BEAM TRANSFORMATION... Sheet 26 of 59





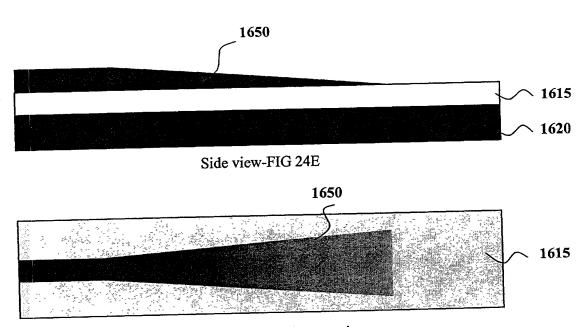
**FIG 23** 

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Photoresist pattern top view-FIG24D

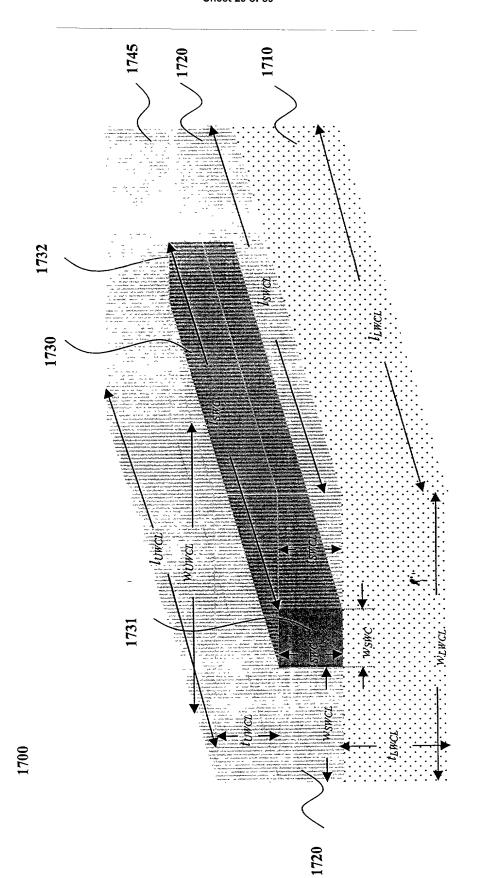
### Atty. Docket No.: 021040-000300 Applicant: Yan Zhou and Seng-Tiong Ho Title: INTEGRATED PLANAR COMPOSITE COUPLING STRUCTURES FOR BI-DIRECTIONAL LIGHT BEAM TRANSFORMATION... Sheet 28 of 59



Si tapered up/wide section top view

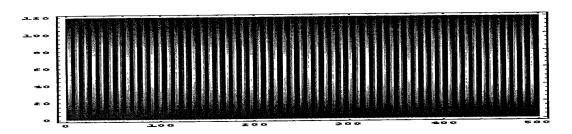
FIG. 24F

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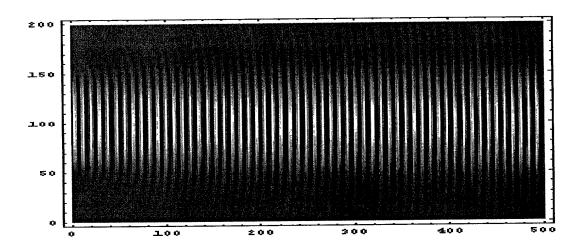


IG 25

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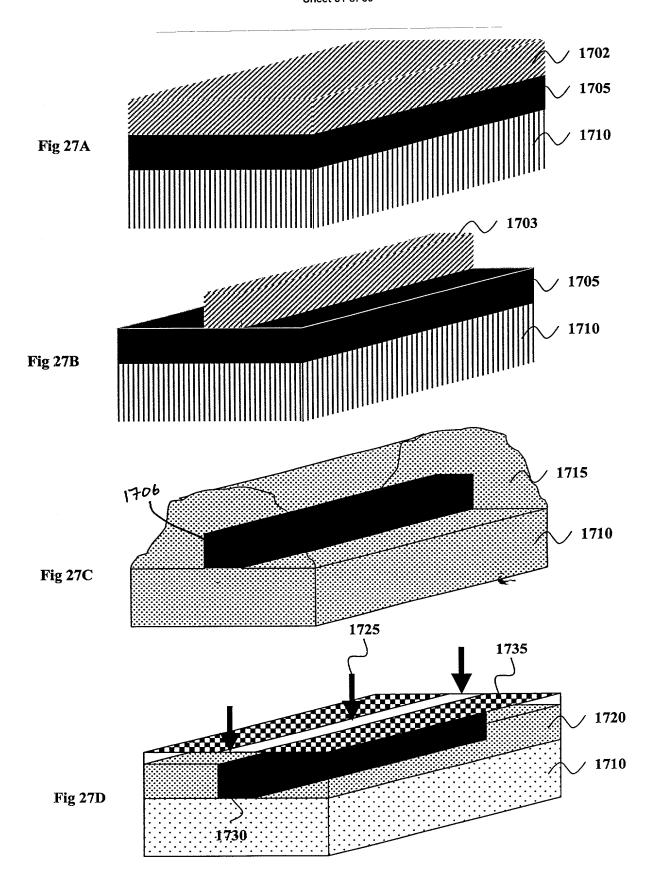
side view



top view

**FIG 26** 

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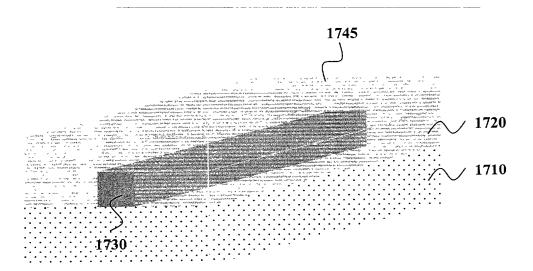
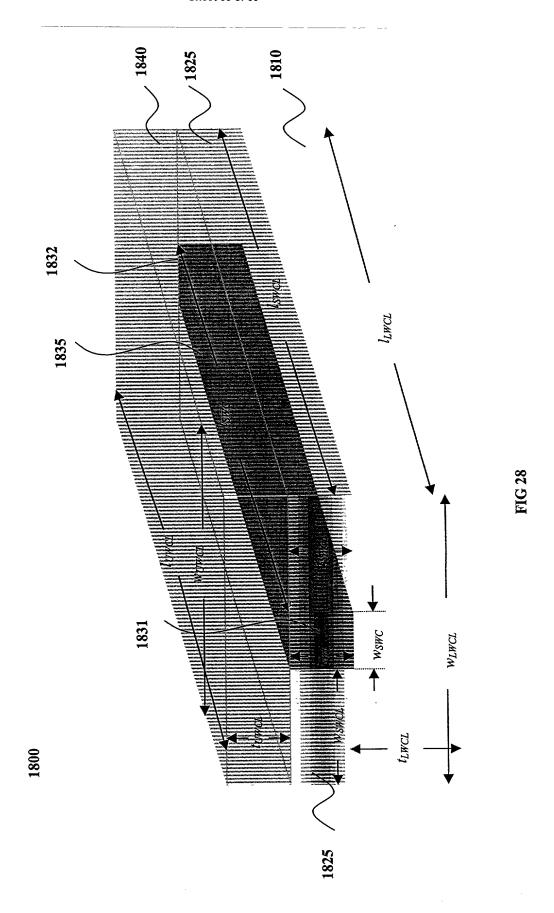
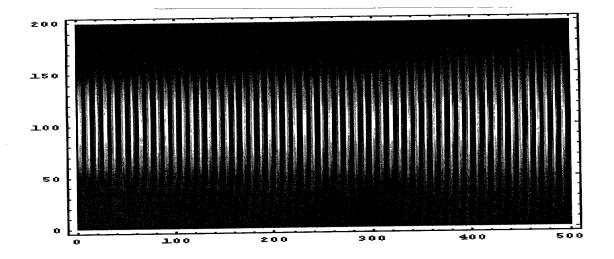


FIG. 27E

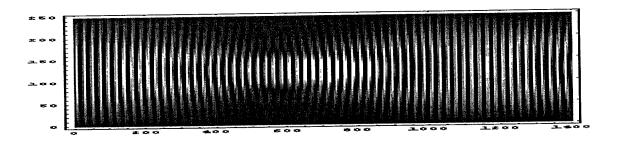
Atty. Docket No.: 021040-000300
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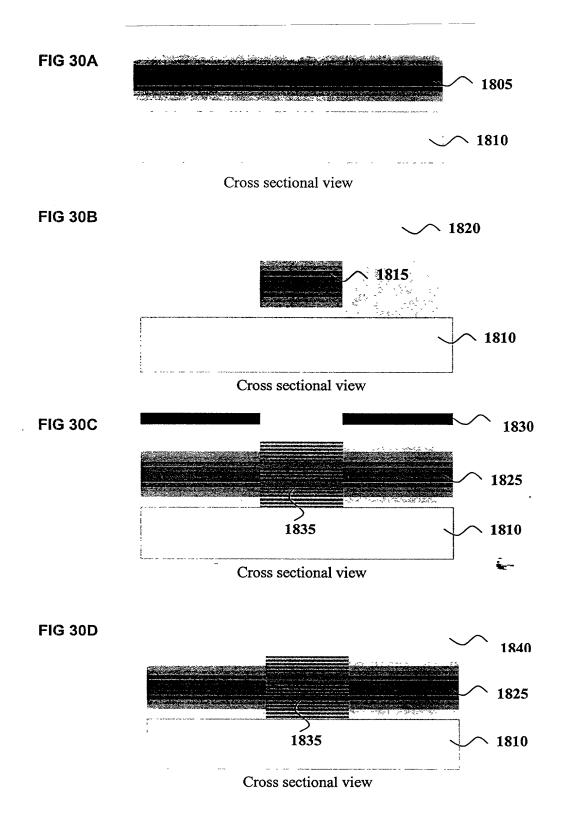
top view



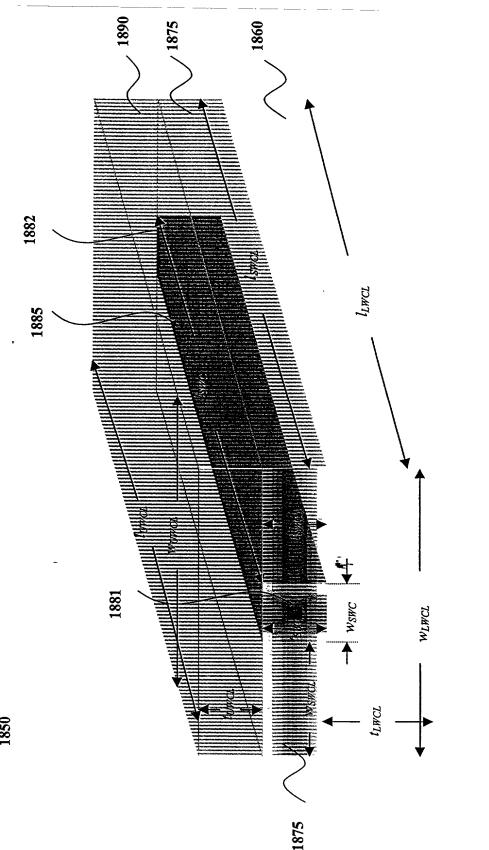
side view

**Fig 29** 

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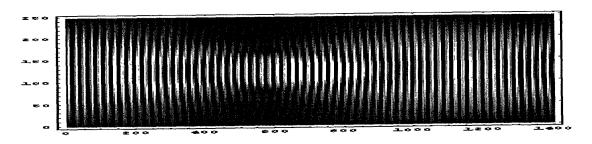


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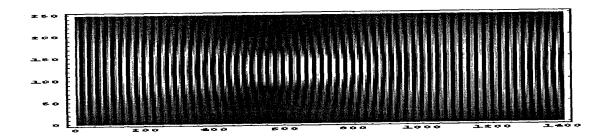


**IG 31** 

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top view



side view

Fig 32

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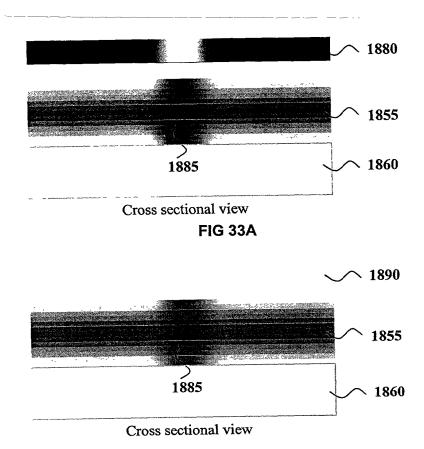
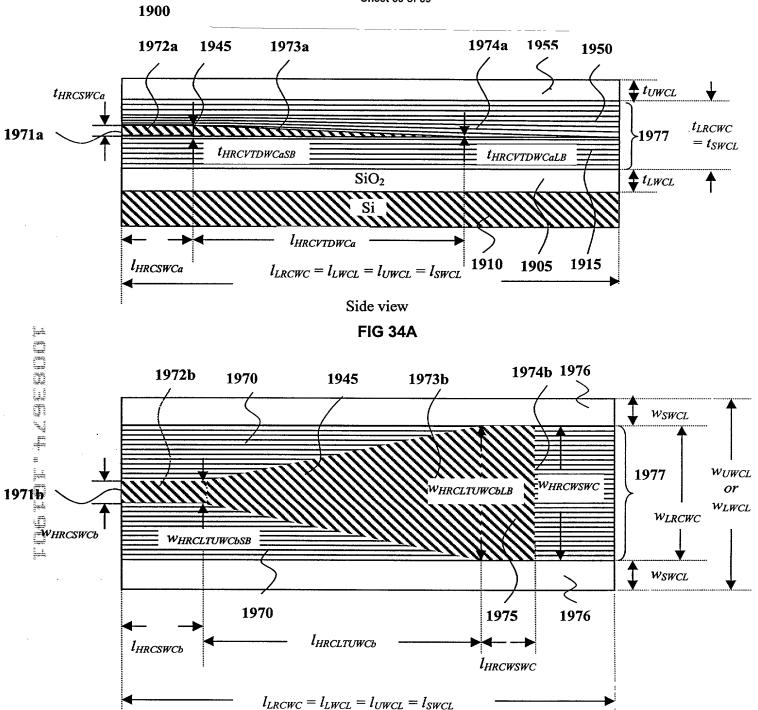


FIG. 33B

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Top view

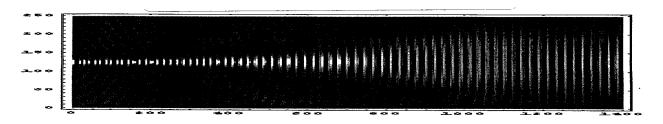
**FIG 34B** 

Atty. Docket No.: 021040-000300

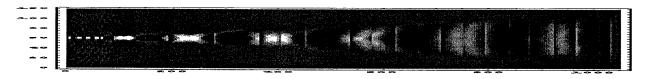
Applicant: Yan Zhou and Seng-Tiong Ho

Title: INTEGRATED PLANAR COMPOSITE COUPLING STRUCTURES
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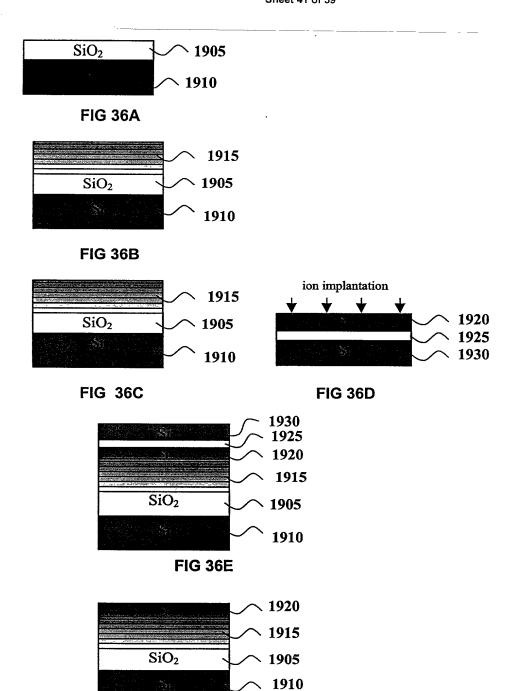
Side view



Top view

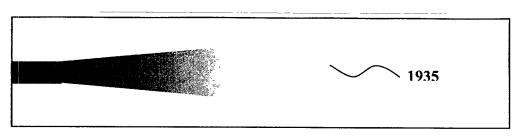
Fig 35

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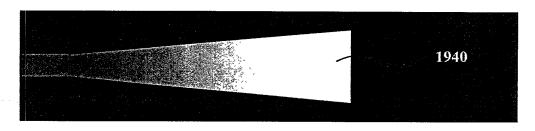


**FIG 36F** 

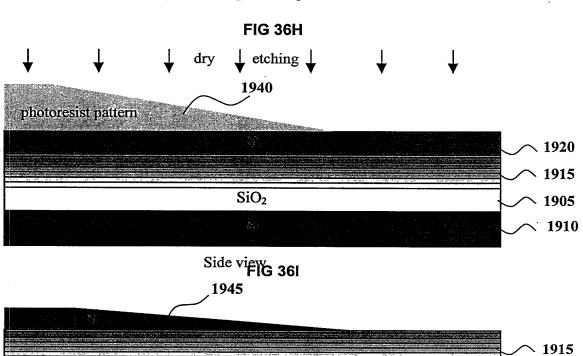
Atty. Docket No.: 021040-000300
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Mask top view FIG 36G



photoresist pattern top view

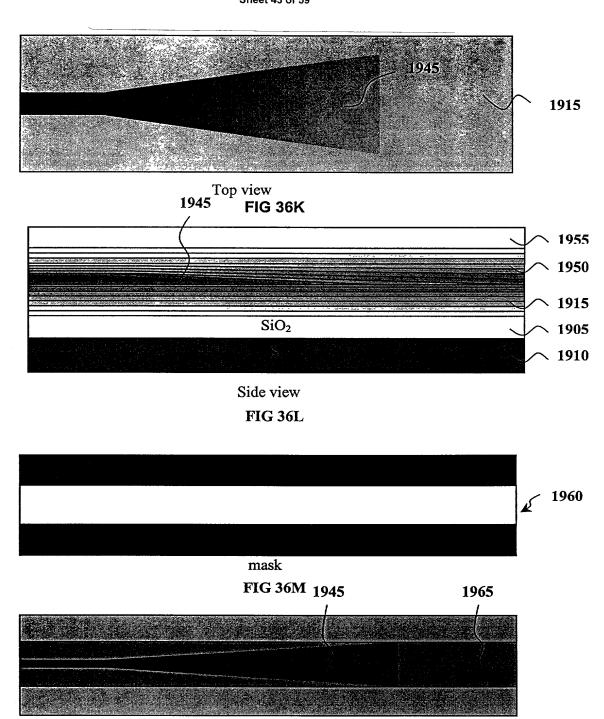


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1910

Side view FIG 36J

SiO<sub>2</sub>

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Top view FIG. 36N

2000 2050 2074a 2055 2045 2072a 2073a  $rac{1}{2}t_{UWCL}$  $t_{HRCSWCa}$  $t_{LRCWC}$ 2071a 2077  $= t_{SWCL}$  $t_{HRCVTDWCaLB}$  $t_{HRCVTDWCaSB}$ SiO<sub>2</sub>  $rac{1}{2}t_{LWCL}$  $l_{HRCVTDWCa}$ 2010 2015 2005  $l_{HRCSWCa}$  $l_{LRCWC} = l_{LWCL} = l_{UWCL} = l_{SWCL}$ Side view **FIG 37A** 2076 2074b 2072b 2070 2045 2073b WSWCL  $w_{UWCL}$ 2077 2071b or $W_{LWCL}$ WHRCLTDWCblb 1  $W_{LRCWC}$ WHRCSWCb WHRCLTDWCbSB WSWCL 2070 2075 2076  $l_{HRCLTDWCb}$  $l_{HRCSWCb}$ 

Top view

 $l_{LRCWC} = l_{LWCL} = l_{UWCL} = l_{SWCL}$ 

**FIG 37B** 

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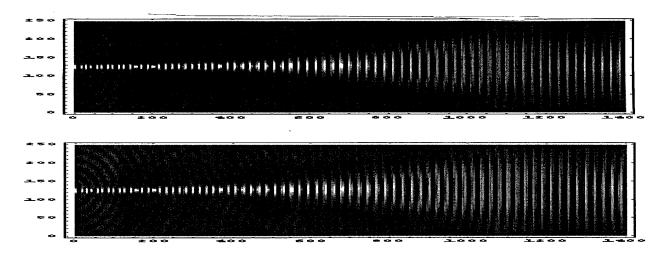
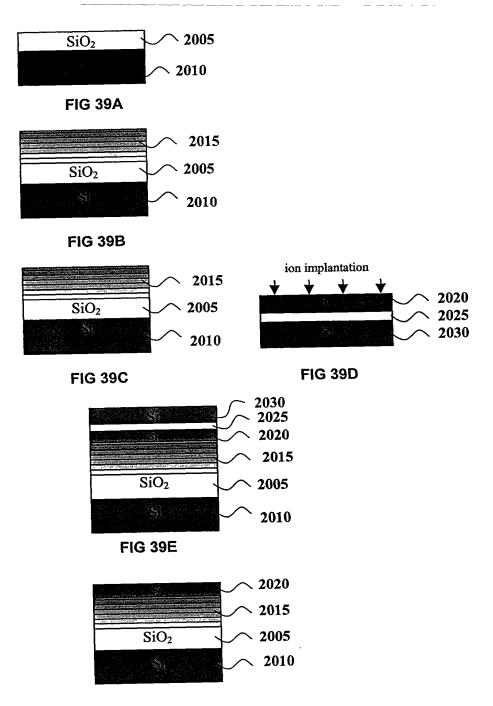


Fig 38

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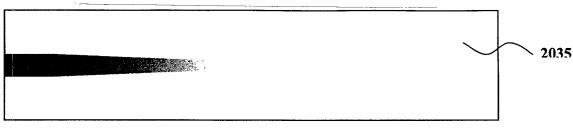
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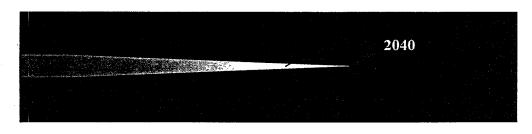


**FIG 39F** 

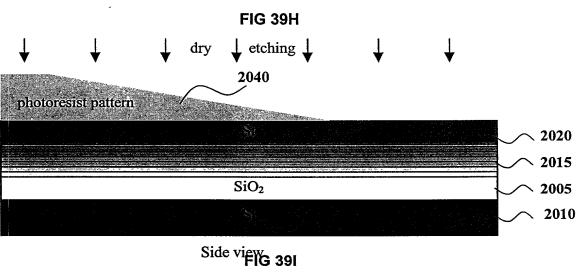
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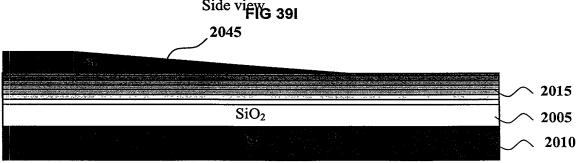


Mask top view FIG 39G



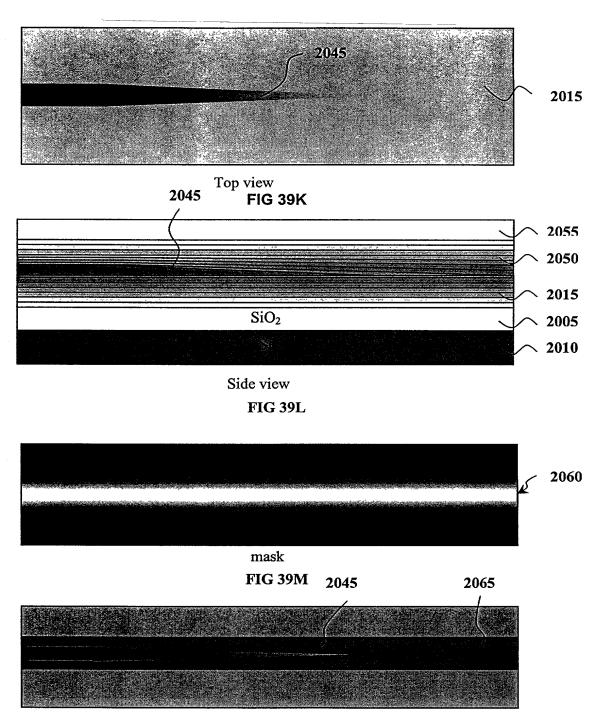
photoresist pattern top view





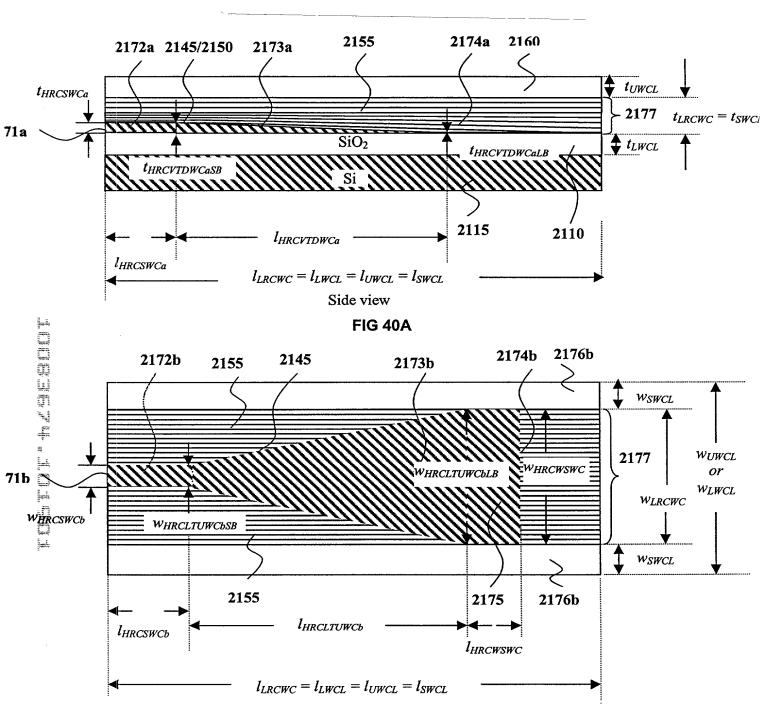
Side view FIG 39J

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Top view FIG. 39N

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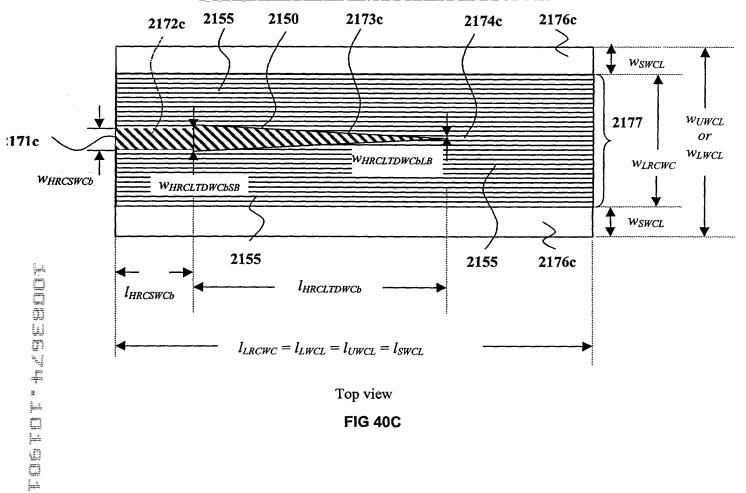
Top view

**FIG 40B** 

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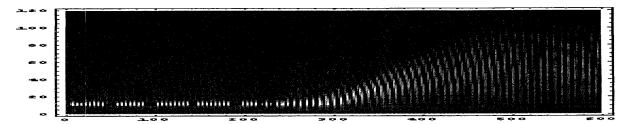
Top view

FIG 40C

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#### Taper side launching

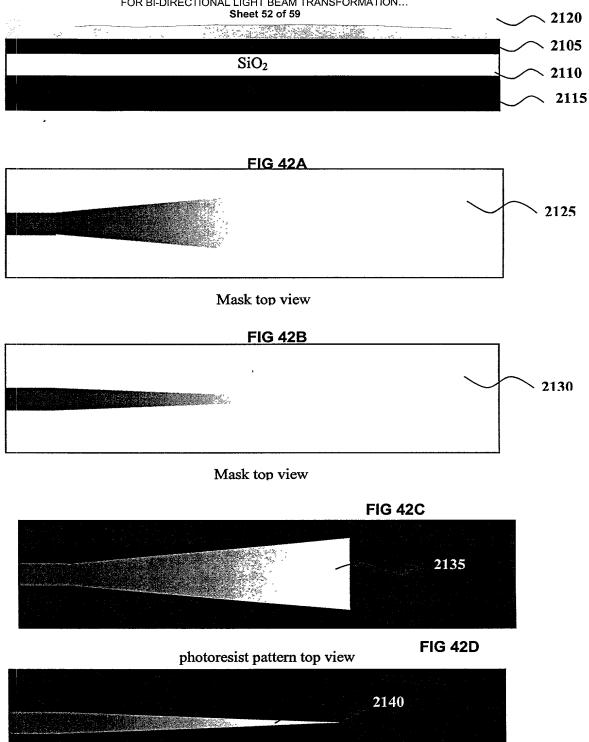


#### GRIN guide side launching



**Fig 41** 

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photoresist pattern top view

FIG 42E

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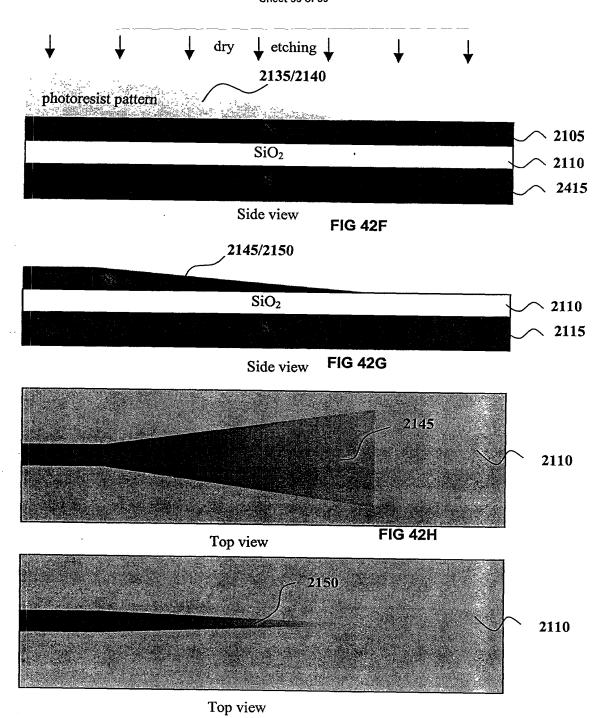
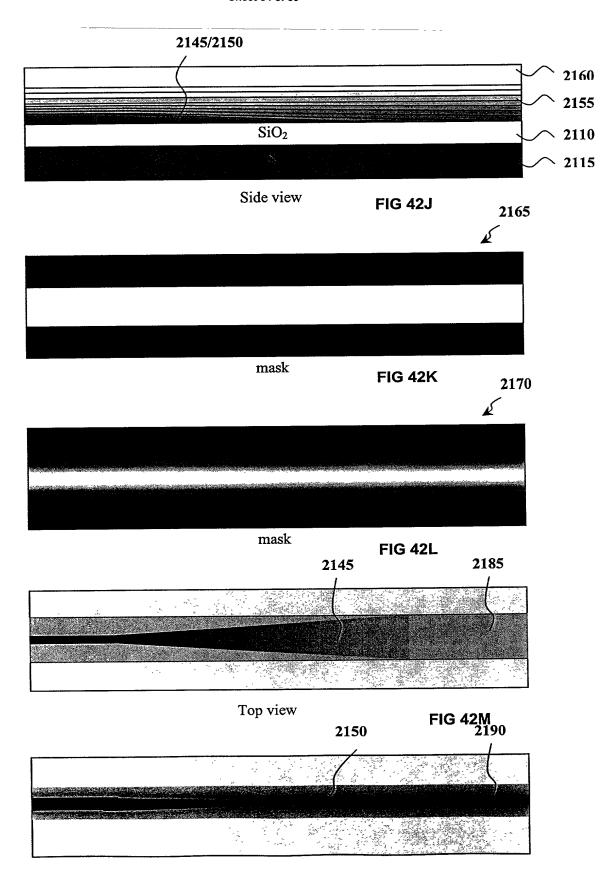
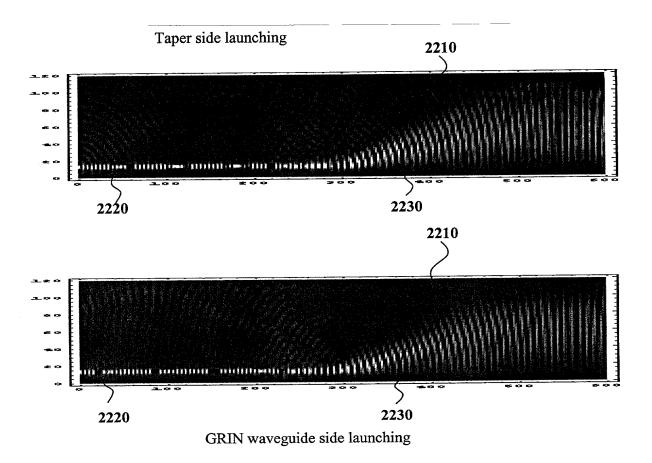


FIG 421

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**Fig 43** 

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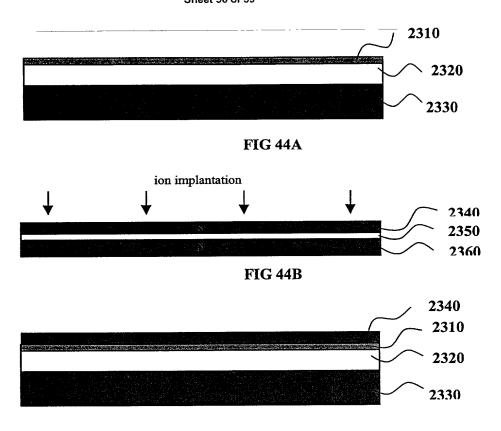
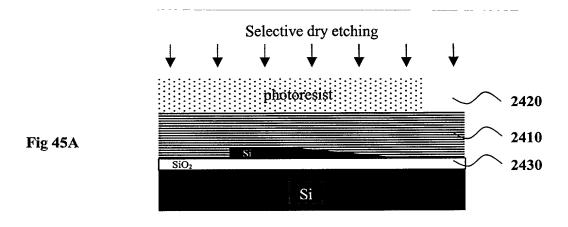
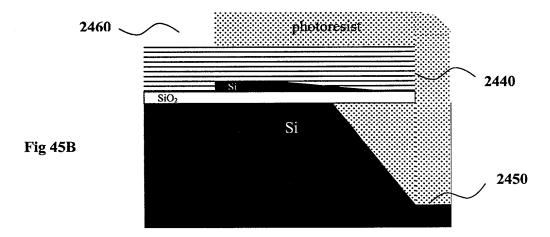


FIG 44C

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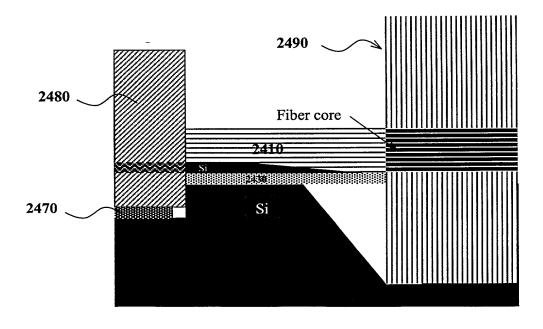
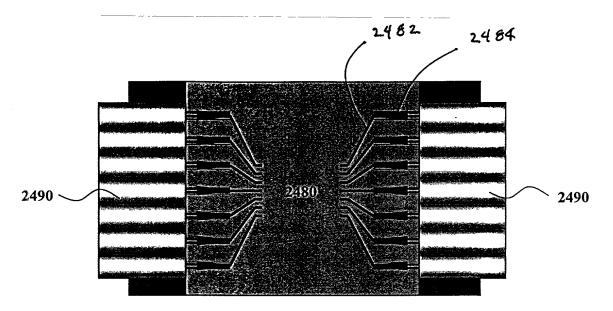


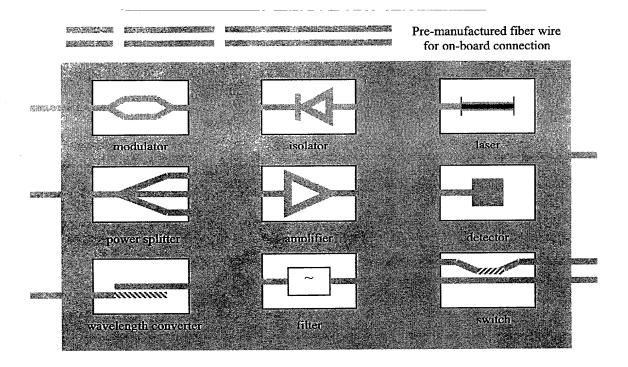
Fig 45C

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**FIG 46** 

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**FIG 47** 

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